

Electronic Educational Resources and Open Electronic Educational Resources as ICT Tools in Distance Learning Implementation in Higher Educational Establishments

Berestok O.

Sumy National Agrarian University, Sumy, Ukraine

Abstract. The article deals with the methodological and theoretical foundations of electronic educational resources (EER) and open electronic educational resources (OEER) used in new realities of educational system functioning. The basic problems of distance learning in higher educational establishments in contemporary terms are determined. The description of basic measures for the introduction of EER and OEER the educational institution is provided. The development and use of EER and OEER in accordance with didactic tasks are shown. The in-depth and objective processes of forming a single open electronic network resource as one of the priority tasks are called. The didactic effectiveness of the application of EER and OEER that can be used in integration with other teaching and methodical materials are mentioned. The general tendencies, content, sources, means, forms and methods of ICT implementation in terms of distance learning are highlighted. A detailed description of relations and interactive communication between the subjects of the educational process is presented. The application of ICT means, such as EER and OEER, which create learning conditions for full interaction with the learning environment is emphasized. The concept of OEER defined as a technologically open provision of educational resources implemented by higher educational establishments to provide distance learning in the educational institutions is defined. The purpose, structure and advantages of OEER are pointed out. The social significance of OEER is established. The analysis of the strategy used in EER and OEER is evaluated. The key instruments and tools of OEER as means to ensure the implementation of personally oriented, individual and differentiated approaches in the educational process are noted. The introduction of didactic and psychological solutions that ensure the adaptation of the electronic resource to the personal qualities of each student is described. The use of the latest pedagogical tools, such as interactivity, multimedia, modeling, communication, productivity is stressed on. The results of the case study of the effectiveness of EER and OEER implementation are presented. Basic challenges for teachers, institutions, and students, provided by EER and OEER are formulated.

Key words: electronic educational resources (EER), open electronic educational resources (OEER), information communication technologies (ICT) didactic effectiveness, higher educational establishments.

Електронні освітні ресурси та відкриті електронні освітні ресурси як засоби ІКТ у впровадженні дистанційного навчання у вищих навчальних закладах

Бересток О. В.

Сумський національний аграрний університет, Суми, Україна

Анотація. У статті розглянуто методологічні та теоретичні основи використання електронних освітніх ресурсів (ЕОР) та відкритих електронних освітніх ресурсів (ВЕОР) у нових реаліях функціонування освітньої системи. Визначено основні проблеми дистанційного навчання у вищих навчальних закладах у сучасних умовах. Подано опис основних заходів щодо впровадження ЕОР та ВЕОР в навчальному закладі. Показано розробку та використання ЕОР та ВЕОР відповідно до дидактичних завдань. Названо глибокі та об'єктивні процеси формування єдиного відкритого електронного мережевого ресурсу як одного з пріоритетних завдань. Відзначено дидактичну ефективність застосування ЕОР та ВЕОР, які можна використовувати в комплексі з іншими навчально-методичними матеріалами. Висвітлено загальні тенденції, зміст, джерела,

засоби, форми та методи впровадження ІКТ в умовах дистанційного навчання. Подано детальний опис інтерактивного спілкування між суб'єктами освітнього процесу. Підкреслюється застосування засобів ІКТ, таких як ЕОР та БЕОР, що створюють умови навчання для повноцінної взаємодії з навчальним середовищем. Визначено поняття БЕОР як технологічно відкрите забезпечення освітніми ресурсами, що реалізується вищими навчальними закладами для забезпечення дистанційного навчання. Вказано призначення, структуру та переваги БЕОР. Встановлено соціальну значущість БЕОР. Оцінюється аналіз стратегії, що використовується в ЕОР та БЕОР. Відзначено ключові інструменти та засоби БЕОР як шляхи забезпечення реалізації особистісно орієнтованого, індивідуального та диференційованого підходів у навчальному процесі. Описано впровадження дидактичних та психологічних рішень, що забезпечують адаптацію електронного ресурсу до особистісних якостей кожного студента. Наголошується на використанні новітніх педагогічних засобів, таких як інтерактивність, мультимедіа, моделювання, комунікація, продуктивність. Наведено результати тематичного дослідження ефективності впровадження ЕОР та БЕОР. Сформульовано основні виклики для вчителів, закладів освіти та студентів, передбачені ЕОР та БЕОР.

Ключові слова: електронні освітні ресурси (ЕОР), відкриті електронні освітні ресурси (БЕОР), інформаційно-комунікаційні технології (ІКТ) дидактична ефективність, вищі навчальні заклади.

Электронные образовательные ресурсы и открытые электронные образовательные ресурсы как средства ИКТ во внедрении дистанционного обучения в высших учебных заведениях

Бересток О. В.

Сумской национальный аграрный университет, Сумы, Украина

Аннотация. В статье рассмотрены методологические и теоретические основы использования электронных образовательных ресурсов (ЭОР) и открытых электронных образовательных ресурсов (ОЭОР) в новых реалиях функционирования образовательной системы. Определены основные проблемы дистанционного обучения в высших учебных заведениях в современных условиях. Представлено описание основных мероприятий по внедрению ЭОР и ОЭОР в учебном заведении. Показана разработка и использование ЭОР и ОЭОР в соответствии с дидактическими задачами. Названы глубокие и объективные процессы формирования единого открытого электронного сетевого ресурса как одной из приоритетных задач. Отмечена дидактическая эффективность применения ЭОР и ОЭОР, которые можно использовать в комплексе с другими учебно-методическими материалами. Отражены общие тенденции, содержание, источники, средства, формы и методы внедрения ИКТ в условиях дистанционного обучения. Представлено подробное описание интерактивного общения между субъектами образовательного процесса. Подчеркивается применение средств ИКТ, таких как ЭОР и ОЭОР, создающих условия обучения для полноценного взаимодействия с обучающей средой. Определено понятие ОЭОР как технологически открытое обеспечение образовательными ресурсами, реализуемое высшими учебными заведениями для дистанционного обучения. Указаны назначение, структура и преимущества ОЭОР. Установлена социальная значимость ОЭОР. Оценивается анализ стратегии, используемой в ЭОР и ОЭОР. Отмечены ключевые инструменты и средства ОЭОР как пути реализации личностно ориентированного, индивидуального и дифференцированного подходов в учебном процессе. Описано внедрение дидактических и психологических решений, обеспечивающих адаптацию электронного ресурса к личностным качествам каждого студента. Отмечается использование новейших педагогических средств, таких как интерактивность, мультимедиа, моделирование, коммуникация, производительность. Представлены результаты тематического исследования эффективности внедрения ЭОР и ОЭОР. Сформулированы основные вызовы для учителей, учебных заведений и студентов, предусмотренные ЭОР и ОЭОР.

Ключевые слова: электронные образовательные ресурсы (ЭОР), открытые электронные образовательные ресурсы (ОЭОР), информационно-коммуникационные технологии (ИКТ), дидактическая эффективность, высшие учебные заведения.

I Introduction

Due to the intensive social development of humanity, which is accompanied by the introduction of new production technologies, the exploitation of natural resources, the growth of information flows and the pace of life, new threats to the population caused by natural, man-made and social factors arise and are actualized. The military aggression against Ukraine, which began on February 24, 2022, became a challenge to the very existence of our state, its sovereignty and unity. The education system of Ukraine found itself in new realities of functioning. Threats to the life and health of participants in the educational process, limiting access to basic human needs; forced large-scale movement of participants in the educational process within Ukraine and abroad, which led to significant losses of the amount of education seekers, pedagogic and teaching staff; large-scale destruction of the educational infrastructure: damage to the premises of educational institutions, the educational material and technical base, educational-production practice bases; aggravation of the problem of

ensuring access to education for Ukrainian schoolchildren and students, violation of the continuity of the educational process and many others have become the significant challenges for education.

To ensure the security situation in institutions of higher education, the educational process was temporarily suspended. Later, the educational process continued using all available forms: online (with the use of ICT and remote access in territories close to the places of hostilities), offline (in territories far from the places of hostilities), in a mixed mode. The Ministry of Education and Science has developed a number of important recommendations for the organization of the educational process in institutions of professional (vocational and technical), professional pre-higher and higher education. In particular, it was recommended to organize the study of the theoretical part of the educational program with the help of distance learning technologies, which does not require the students and teaching staff to visit educational institutions. Junior year students are given the opportunity to transfer the hours of theoretical and practical training to the next academic year. At the same time, it is recommended to provide special study conditions (setting an individual schedule, granting academic leave, etc.) for those students who are in the ranks of the Armed Forces or territorial defense units, engaged in volunteer activities, and to make changes to the approved schedule of the educational process taking into account current events. To implement an individual curriculum and check completed tasks, teachers are recommended to use communication tools, in particular: placing tasks and recommendations on the institution's website; creation of groups with students in social networks (Viber, Telegram, WhatsApp, etc.); use of electronic platforms (ZOOM, Google Classroom, etc.); conducting Skype conferences; communication in telephone mode; correspondence via e-mail, etc.

In the realities of today's education, when the new educational paradigm generates in-depth and objective processes of forming a single open electronic network resource, one of the priority tasks of the Ministry of Education and Science is the modernization of the content of education. Such modernization should be carried out by actively using modern ICT and removing all obstacles. The Law of Ukraine "On Education" states that everyone has the right to access the Internet and different educational resources, including multimedia educational resources, in the manner determined by the legislation (Article 3. The right to education). The distance form of education involves full or mostly mastering the educational program in an interactive mode using ICT tools and electronic educational resources (EER) [8, 13], distant from the student of education. The methodological and theoretical foundations of the creation of EER are described in scientific research of domestic scholars, namely: Bykov, Hurevych, Hurzhii, Zhuk, Kukharenko, Lapinskyi, Oliinyk, Spivakovskiy, Stefanenko, and others.

The theory of open EER (OEER) was first defined at the UNESCO Forum on the Impact of Open Courseware for Higher Education in Developing Countries [1]. According to the scientific concepts of the researchers, the development and use of OEER in accordance with didactic tasks allow to implement manual, visual or audiovisual forms, manage the external typical and special devices and devices (computer-oriented teaching aids) that are part of laboratory complexes or kits, etc. To increase the didactic effectiveness of the application of OEER, they can be used in integration (synchronously or asynchronously) with other teaching and methodical materials (for example, methodical recommendations), forming integrated program and methodical complexes. The scientific novelty of the paper is that the innovative method of creating open educational resources based on ICT has gained further development. The relevance of the study is to determine the optimal and effective conditions for methodically justified use of modern OEER as information support in a higher educational institution in order to strengthen motivation and activate the educational process.

II Materials and Methods

The information environment, which is implemented on the basis of the integration of specialized software tools and educational content, is the basis of relations and interactive communication between the subjects of the educational process — teachers and students. The information environment is a practical toolkit for preparing and conducting lessons, creating electronic educational materials and providing students with access to online educational resources. According to the concept of innovative learning technologies, the educational environment consists of material, resource and informational components. The information technology

component of the educational environment refers to ICT and allows to organize the educational activities of students at a qualitatively new level, performing motivational, illustrative, generalizing, control functions [7, 11].

Such ICT means are EER, which create such learning conditions when, thanks to the computer, a student directly participates in events and processes, and fully interacts with the learning environment, which simulates the objects and processes of the real world.

Electronic educational resources are considered to be educational, scientific, informational, reference materials and tools, developed in electronic form and presented on any type of media or placed in computer networks, which are reproduced with the help of electronic digital technical means and are necessary for effective organization of the educational process, providing it with high-quality educational and methodological materials, have an educational and methodological purpose and are used to ensure the educational activity of the educational institution being one of the main elements of the informational and educational environment.

The concept of OEER designing is based on personally oriented, differentiated and integrative approaches in education and didactic principles (persistency, consistency, accessibility, differentiated approach, scientific background), as well as principles of adaptability to the individual characteristics of each student), manageability (possibility of adjusting the learning process by the teacher at any stage), interactivity (communication of the subjects of the educational process), optimality (combination of individual and group work; maintenance of the state of psychological comfort of pupils/students, unlimited learning content, etc.) [14, 10].

The concept of OEER can also be defined as a technologically open provision of educational resources for consultation, use and adaptation by a community of users for non-commercial purposes. These educational resources are publicly available on the Internet and include textbooks, videos, podcasts, and any other materials related to learning, such as teacher guides, lesson plans, experiments, demonstrations, and curricula. Faculty and students have access to these resources without obligation to pay or make licensing fees [2].

The key idea of the concept was the understanding of the leading role of ICT in the organization of the educational process, which opens up wide prospects for the formation of fundamental and professional knowledge of students, the strengthening of the applied orientation of the content of education, the disclosure of the creative potential of students and teachers according to their requests and abilities.

In the justification of the methodology for the creation of OEER, the provisions of the "National Strategy for the Development of Education in Ukraine for the period until 2021", "Concept for the Development of Education of Ukraine for the period 2015-2025" were taken into account and proposed to ensure the proper quality of education by introducing ICT into the educational process by creating full courses, course modules, open textbooks, curricula, lectures, student guides, teaching notes, laboratory and classroom activities, teaching materials, videos, interactive materials, assessment tools and many other resources, software, applications (including mobile applications) and any other useful educational materials.

The purpose of OEER is to modernize the content of education, ensure equal access of participants in the educational process to high-quality educational and methodical materials regardless of their place of residence and form of education, increasing the independence of students' educational and cognitive activities. The innovative method of creating OEER is a step-by-step logically built procedure, namely: formation of information content (selection of content material and additional and auxiliary information; correction and layout of material (in accordance with the curriculum); technical implementation (substantiation and selection of software tools and WEB technologies (systems and platforms), which can be used as a toolkit; designing a template; choosing visualization tools) and implementing and evaluating the work done.

The structure of OEER is designed in such a way that it contains a flexible content management system (cross-references, hyperlinks to external and internal objects, etc.), a built-in system of internal navigation, management of graphic objects and the use of external depositories, a hypermedia system, moving elements, drop-down panels (for example, a table of contents), the ability to zoom, the ability to create electronic bookmarks, searching by keyword or phrase, providing page-by-page access to the material, providing ease of navigation and much more.

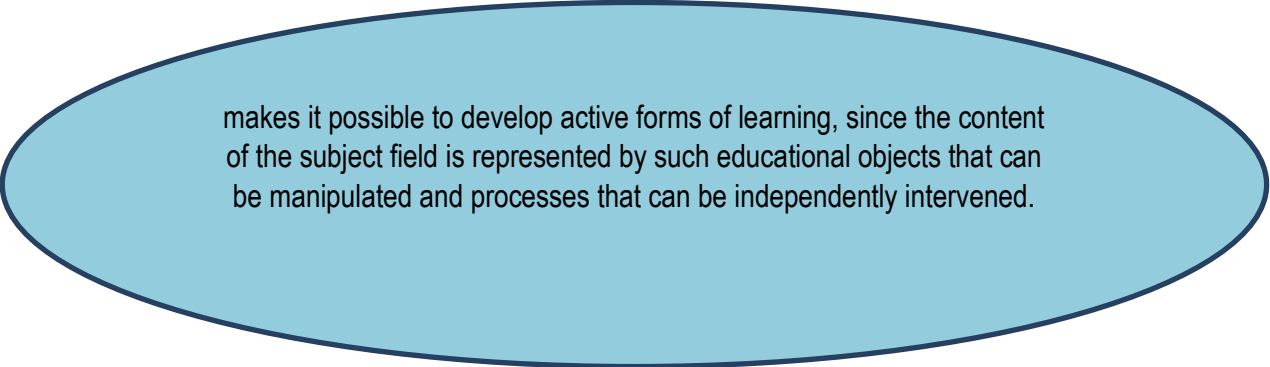
The advantages of the developed OEER according to the outlined methodology are free (technically and legally) access to the content for all participants of the educational process; animation of illustrative material, which allows you to visually demonstrate certain processes that cannot be shown when using traditional teaching tools; the ability to choose the depth of study of the topic (differentiation of learning) due to the use of cross-references and hyperlinks; dynamism and openness (the ability to supplement and change textual or illustrative material); the opportunity to actively use such pedagogical technologies as a problem-based presentation of lecture material, a heuristic method of conducting practical, laboratory classes, problem-oriented, business and role-playing games that simulate elements of possible future professional preferences of students due to the simulation of various industrial situations, which brings the educational process closer to the conditions possible real professional activity.

III Results

The social significance of OEER is based on the fact that the developed innovative methodology has a clear direction for the innovative renewal of the modern education system in Ukraine. The use of open electronic educational resources developed taking into account modern requirements will contribute to the achievement of one hundred percent provision of educational institutions with educational resources. It should be noted that the use of OEER in the educational process ensures the implementation of personally oriented, individual and differentiated approaches.

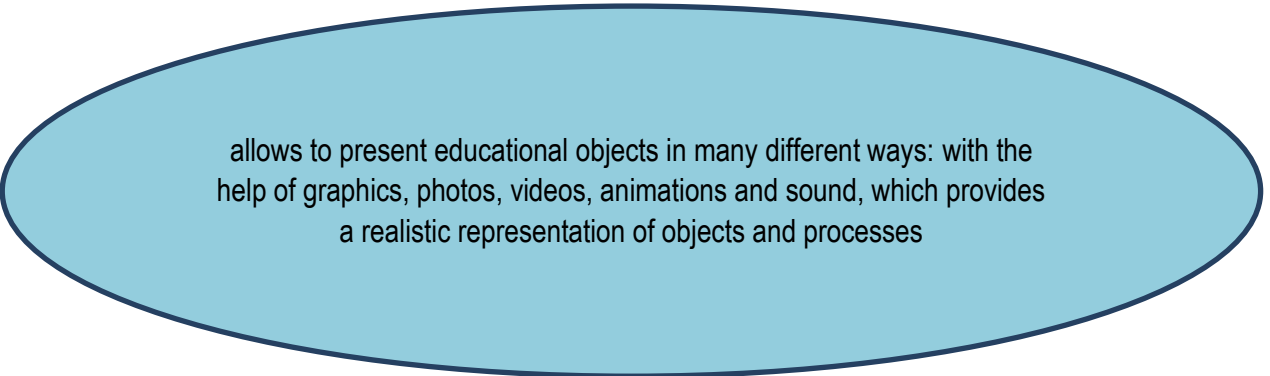
The result of work on OEER is the achievement of the set goal, namely the scientific substantiation of innovative technology, which involves the use of ICT technologies - a freely distributed toolkit that allows the use of the latest pedagogical tools, such as interactivity, multimedia, modeling, communication, productivity.

Figure 1 presents the advantages of implementation of such tool as *Interactivity* which



makes it possible to develop active forms of learning, since the content of the subject field is represented by such educational objects that can be manipulated and processes that can be independently intervened.

Figure 2 demonstrates the positive characteristics of *Multimedia* that



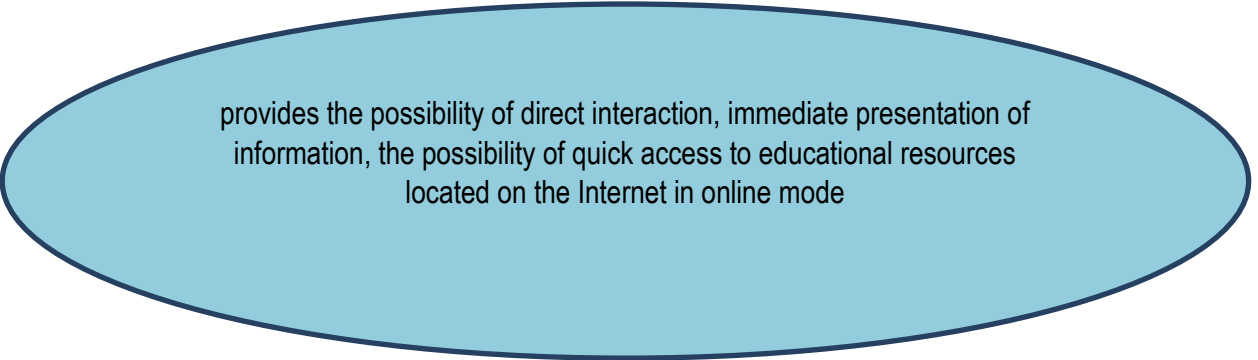
allows to present educational objects in many different ways: with the help of graphics, photos, videos, animations and sound, which provides a realistic representation of objects and processes

Figure 3 shows that *Modeling*



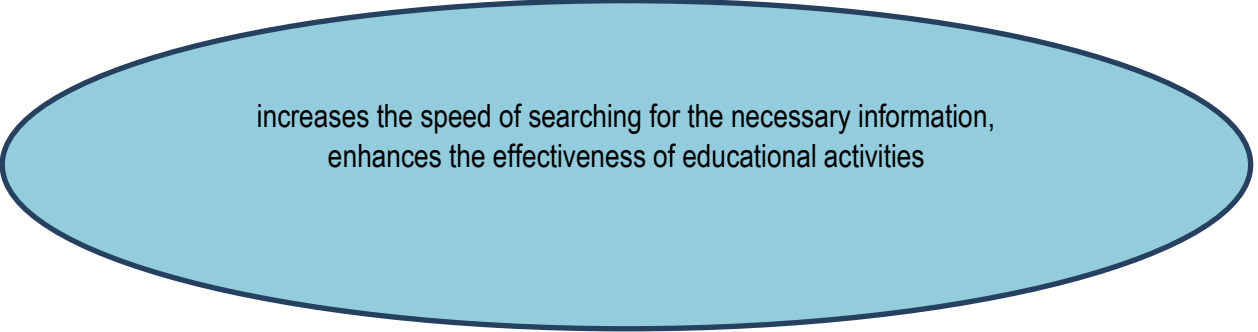
implements reactions typical for the study of objects

Figure 4 describes *Communication* as an instrument that



provides the possibility of direct interaction, immediate presentation of information, the possibility of quick access to educational resources located on the Internet in online mode

Figure 5 deals with *Productivity* which



increases the speed of searching for the necessary information, enhances the effectiveness of educational activities

New-generation educational resources, which are a component of the information technology component, are open educational modular multimedia systems that consist of electronic modules of three types: informational, practical, and test. Thanks to the modularity of such systems of modern educational resources, it is possible to use all five new pedagogical technologies, and for teachers to create author's training courses and individual educational strategies for students.

It is obvious that it is possible to expect an increase in the efficiency and quality of education from digitalization only if modern educational products have innovative qualities.

1. Provision of all components of the educational process:

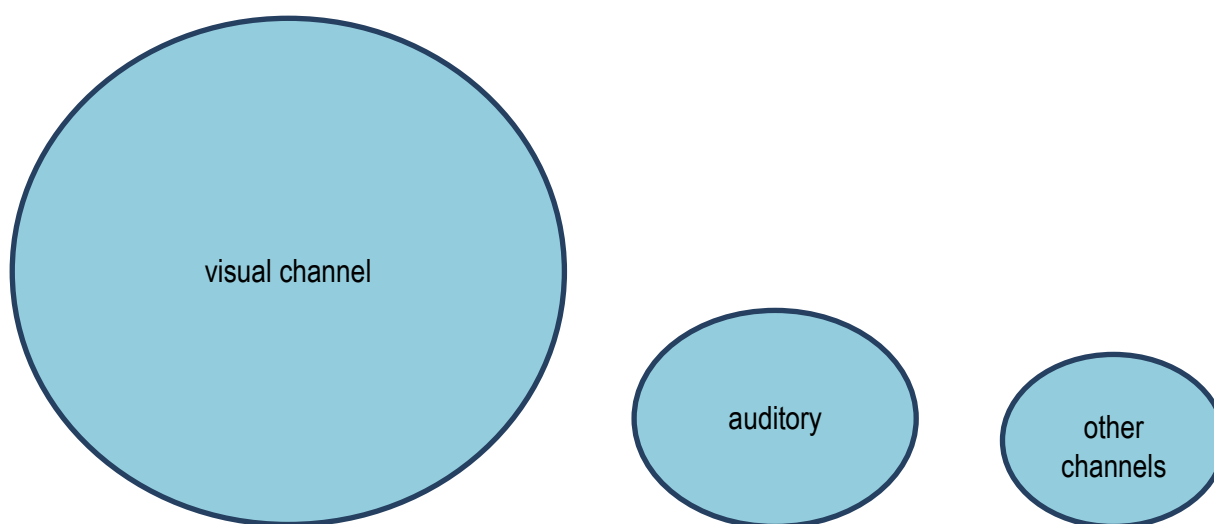
- receiving information;
- practical classes;
- attestation.

2. Interactivity, which provides a sharp expansion of opportunities for independent educational work due to the use of active forms of learning.
3. The possibility of more complete distance learning. The full value in this case is the implementation outside the classroom of such types of educational activities that previously could be performed only by studying in the classroom.

One of the significant achievements can be considered the introduction of didactic and psychological solutions that ensure the adaptation of the electronic resource to the personal qualities of each student. The use of computer programs creates prerequisites for the transition to active thinking in the process of solving experimental and computational problems and acquiring skills and abilities.

Another important factor is the absence of a psychological barrier, which often prevents interaction between a teacher and a student. It was established that conducting classes using computer presentation has a number of advantages, since 85% of information enters the human brain through the visual channel of perception, 10% - through the auditory and only 5% falls on all other channels of perception.

Figure 6 demonstrates the visual difference between channels of perception



Classes using ICT allow you to actively use several channels of perception at the same time, increasing the effectiveness of learning and memorizing information. Based on this, it is possible to assume that the effect of application depends on the ability to use new opportunities. It is important to include these technologies in the education system of each student, to provide him/her with a choice of forms and means of activity in solving his/her educational tasks.

IV Discussion

In the Regulations on electronic educational resources, approved by the Order of the Ministry of Education and Science, Youth and Sports of Ukraine dated October 1, 2012 N 1060 (as amended by the Order of the Ministry of Education and Science of Ukraine dated May 29, 2019 N 749) [15] it is noted that EER are teaching aids on digital media of any type or those placed in computer networks, which are reproduced with the help of electronic digital technical means and are used in the educational process.

Bykov and Lapinsky suggest that EER should be understood more broadly as "a set of electronic information objects (documents, documented information, instructions, information materials, etc.), information-object content of electronic information systems (electronic libraries, archives, data banks, information- communication networks, etc.) intended for information support for the functioning and development of the education system"

and divide them according to the scope of application into three groups: for educational purposes, for supporting scientific research and for management [3].

In the publications of Fedasyuk, Datsenko and others distribution of EOR includes the following groups, namely: educational-methodical EOR (curriculums, working programs of educational disciplines developed in accordance with curricula); methodical EOR (methodical guidelines, methodical manuals, methodical recommendations for studying a separate course and project management of works, thematic plans); educational EOR (electronic textbooks and training aids); auxiliary EOR (collections of documents and materials, directories, indexes to educational and educational literature, scientific publications of teachers, materials of conferences, electronic directories, dictionaries, encyclopedias); control EOR (test programs, banks of control questions and tasks in academic disciplines and other EOR that provide control quality of knowledge) [4, 5].

Lytvynova, researching the issue of improving the education system of Ukraine, suggests that the modernization of the national education system necessitates the search for new approaches to the organization of the educational process. She also stresses that electronic educational resources are one of the components of the educational process, used to provide various types of educational activities of students in classroom, independent, individual and distance learning forms. Currently, according to her research, the task of effective use of EER for the construction and organization of interaction of all subjects of the educational process is being solved. Prospects for the development of various learning technologies are associated with the use and creation of EER, which allow managing group, independent and individual work of students at a fundamentally new organizational level. Litvynova also notes that in order to organize the educational process with the use of EER, it is important for the teacher to learn how to search and select them in accordance with the existing conditions, determine the feasibility of their use at different stages of the lesson, and evaluate the results of the activities of pupils/students using them [12].

Sokorko points out the following EER which provide the following opportunities, namely: general educational purpose:

programs and websites for creating flashcards and quizzes (Kahoot!, Socrative, Quizlet);

electronic libraries (Europeana, Ukrainian Center, Tuva Lab;

Web - services for group work (Google Apps for Education, Microsoft Office 365 online);

tools for creating mental maps (MindMeister, Freemind, Bubble, MindMup);

search engines (Google, Yahoo!, Baidu);

online resources centers (KQED Education, High-Adventure Science)

laboratories (NOVA Labs, GoLab, GeoGebra);

simulators (PhET Interactive Simulations project) [17].

Savchenko defines EOR as an information resource that is stored in an electronic or computerized format and can be reached, found and transformed by electronic means network or other electronic data processing technology [16].

Horovy emphasizes that it is the information resource in the period of dynamic of these global transformations becomes the most important for humanity and is its foundation he argument before the challenges of modernity, a perspective factor for further social development [6].

A group of scientists (members of the scientific-methodological commission for the digitalization of educational institutions of the Scientific and Methodological Council of the Ministry of Education and Culture of Ukraine headed by Kalinina) draw attention to the fact that the use of EOR corresponds to the global trend in economics — the emergence of new types and forms of socially useful activity, changes in transformational activity of man from mainly material objects on intangible objects, which contributes to the transformation of all branches of the economy: "full training of transformative activity, like any other kind activity, impossible without the

implementation of elements of this activity in the form of activities relations with the objects of study or their models" [9].

V Conclusion

Consequently, new electronic educational resources open up modern technological learning options associated with the unique capabilities of computers and telecommunications. The purpose of creating and using such EER is to modernize education, ensuring equal access of participants in the educational process to high-quality educational and methodical materials regardless of their place of residence and form of education, created on the basis of information and communication technologies.

Due to the use of EER, the first component of learning, obtaining information, is being updated. The usual processing of textual descriptions of objects, processes and phenomena is replaced by the study in an interactive mode. The most obvious new opportunities are in the study of ideas about the macro- and micro world, many other objects and processes that cannot be observed in the real environment. The main thing that such resources provide teachers with much more interesting and effective tool to work with students, and at the same time, the informational learning environment is expanded.

However, the teacher faces a rather difficult task of finding answers to questions about the effectiveness of available resources, about methodological techniques for using Internet resources that allow to achieve the predicted results. The problem of choosing effective EER electronic resources that contribute to the realization of new educational goals is one of the urgent problems today. The use of modern educational resources is a way to increase student motivation, expand the range of learning tools, and implement complex tasks in a virtual environment.

Electronic educational resources of the new generation, built on a modular architecture, contain highly interactive, multimedia-rich content and enable the implementation of active forms of learning that ensure the independent educational activity of the student as a subject of cognition, self-improvement and development, expand the possibilities of pedagogical methods and techniques of the teacher and can be adapted to various pedagogical technologies.

The modular architecture of EOR, their information saturation and wide multimedia capabilities allow the chemistry teacher to build the educational process so that the knowledge acquired by students is not isolated, but becomes a system. Increasing the share of independent educational activity of students provides an opportunity to develop their skills in searching and analyzing information, the ability to structure educational material, find the main point and place emphasis.

The modular organization of EOR, which involves the use of variable educational modules with different levels of complexity of the taught material, ensures invariance in the formation of educational programs and, therefore, makes it possible to apply them in classes.

Students need EOR to get additional information on researched problems, share their thoughts and discuss the learning process with other students and the teacher. Teachers have the opportunity to more effectively create courses using multimedia resources that require special technical and media skills, learn about new teaching methods, create resources and discuss them with colleagues, join professional communities. Educational institutions can demonstrate educational and scientific programs to a wide audience, attract a larger number of applicants, and reduce costs for the development of educational courses.

Therefore, in order to create and maintain conditions for distance learning, it is important to select the necessary EOR and VEOR, which will ensure the educational needs of the participants of the educational process, namely: collaborative work on tasks; working out ideas for solving problems; search for scientific material; visualization and presentation of research, etc. The purpose of such an environment is to facilitate the learning of students to apply the knowledge of disciplines not focused on a specific concept or discipline, but on solving a problem close to real life.

Organizational and methodological approaches to the creation of OEER will contribute to the development of prerequisites for the formation of an information and educational environment not only within the educational institution, but in the future in e-platforms of OEER for the education system of the country as a whole.

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Бересток Ольга Володимирівна.

Старший викладач кафедри іноземних мов, Сумський національний аграрний університет,
вул. Г. Кондратьєва 160, Суми, Україна, 40000.
Тел. 0955555018. E-mail: berestok.o@gmail.com

Berestok Olha Volodymyrivna.

Senior Lecturer of the Foreign Languages Department, Sumy National Agrarian University,
G. Kondratiyev Street 160, Sumy, Ukraine, 40000.
Tel. 0955555018. E-mail: berestok.o@gmail.com

ORCID: 0000-0001-7912-9592

Researcher ID: V-4039-2018